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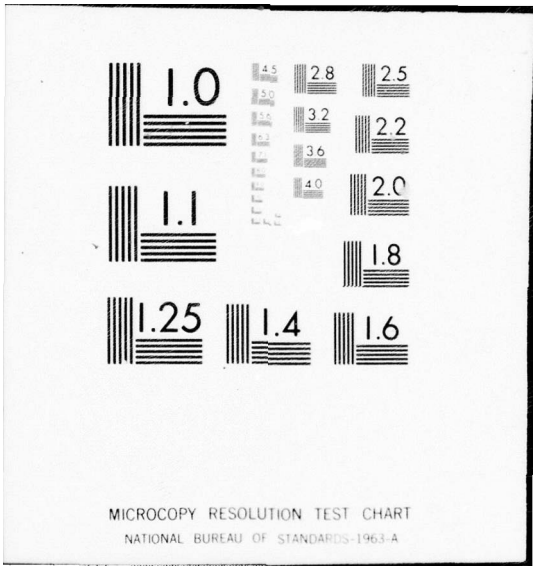
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SOFTWARE ACQUISITION MANAGEMENT GUIDEBOOK: REVIEWS AND AUDITS

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Physical Configuration Audit
Formal Qualification Review

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

This report is one of a series of Software Acquisition Management Guidebooks which provide information and guidance for ESD Program Office personnel who are charged with planning and managing the acquisition of command, control, and communications system software procured under Air Force 800 series regulations and related software acquisition management concepts. It combines existing guidance regarding reviews and audits currently contained in a number of different official documents into a single document and narrows

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20. ABSTRACT (Con't)

the focus of existing guidance to those problems inherent in software acquisition management. Where appropriate, existing guidance is extended to include practices and procedures based on the practical experience of the author and others in acquiring software. The objective of this document is to instruct Air Force Program Office personnel in the effective use of reviews and audits as management tools in acquiring software.

PREFACE

This report was prepared by System Development Corporation under the direction of the Computer Systems Engineering Directorate of the Electronic Systems Division (ESD/MCI), Air Force Systems Command. The Reviews and Audits guidebook is one of a series of Software Acquisition Management guidebooks intended to help ESD Program Office personnel in the acquisition of embedded software for command, control and communications systems. The contents of the guidebooks will be revised periodically to reflect changes in software acquisition policies and practices as well as feedback from guidebook users.

The Software Acquisition Management guidebook series is currently planned to cover the following topics (National Technical Information Service accession numbers for those already published are shown in parentheses):

Regulations, Specifications and Standards* (AD-A016401)

Contracting for Software Acquisition (AD-A020444)

Monitoring and Reporting Software Development Status (AD-A016488)

Statement of Work Preparation (AD-A035924)

Reviews and Audits

Computer Program Configuration Management

Computer Program Development Specification (Requirements Specification)

Software Documentation Requirements (AD-A027051)

Verification

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Overview of the SAM Guidebooks

Software Maintenance

Software Quality Assurance

Software Cost Estimation and Measurement

Software Development and Maintenance Facilities (AD-A038234)

Life Cycle Events (AD-A037115)

*To be revised by March 1978.

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SECTION 1 - INTRODUCTION

1.1 PURPOSE

Several Air Force regulations, specifications, and standards provide guidance on the conduct of reviews and audits in the acquisition of systems and computer program configuration items. This guidebook (1) combines existing guidance regarding reviews and audits currently contained in a number of different official documents into a single document, and (2) narrows the focus of existing guidance to those problems inherent in software acquisition management. Where appropriate, existing guidance is extended to include practices and procedures based on the practical experience of the author and others in acquiring software. The objective of this document is to instruct Air Force Program Office personnel, and an evolving position within the Engineering Division (referred to herein as the Software Director), in the effective use of reviews and audits as management tools for the acquisition of software.

1.2 SCOPE

The scope of this guidebook is limited to engineering design reviews and configuration management audits related to the acquisition of computer program configuration items (CPCIs) procured as part of a command, control, and communications (C^3) system. Detailed guidance is provided for the following formal reviews and audits:

- System Requirements Review (SRR)
- System Design Review (SDR)
- Preliminary Design Review (PDR)
- Critical Design Review (CDR)
- Functional Configuration Audit (FCA)
- Physical Configuration Audit (PCA)
- Formal Qualification Review (FQR)

1.3 PURPOSE OF ENGINEERING DESIGN REVIEWS

Engineering design reviews provide the Program Office (PO) with a tool for monitoring the developing organization's technical progress. Design reviews are milestones between baselines which provide visibility into the technical progress of a particular phase within the system acquisition life cycle. A baseline is a point of control normally defined by an approved contract specification. Normally, design reviews are phase oriented and directly related to the specific level of detail available at the time of the review. The SRR and SDR are normally Validation Phase reviews and are used to monitor the progress of detailing the system/segment requirements and allocating these requirements to configuration items (CIs). The PDR and CDR are normally conducted during the Full-Scale Development Phase and are used to monitor the developer's design progress as they design and develop the associated CIs. Primary responsibility for the conduct of design reviews is assigned to the contractor with participation from the PO.

1.4 PURPOSE OF CONFIGURATION MANAGEMENT AUDITS

Configuration management audits are used to determine if specific contractual requirements have been accomplished. For the acquisition of CPCIs all configuration management audits are associated with the Full-Scale Development contract. The primary responsibility for the conduct of configuration management audits belongs to the PO with the developer playing a support role.

1.5 SEQUENCE OF SYSTEM/CPCI REVIEWS AND AUDITS

Figure 1 relates system and CPCI-level reviews and audits. The tasks in the Validation and Full-Scale Development Phases can be accomplished by either industry or in-house agencies. The term "developer" is used to refer to the organization responsible for performing the tasks, whether it be in-house or contractor.

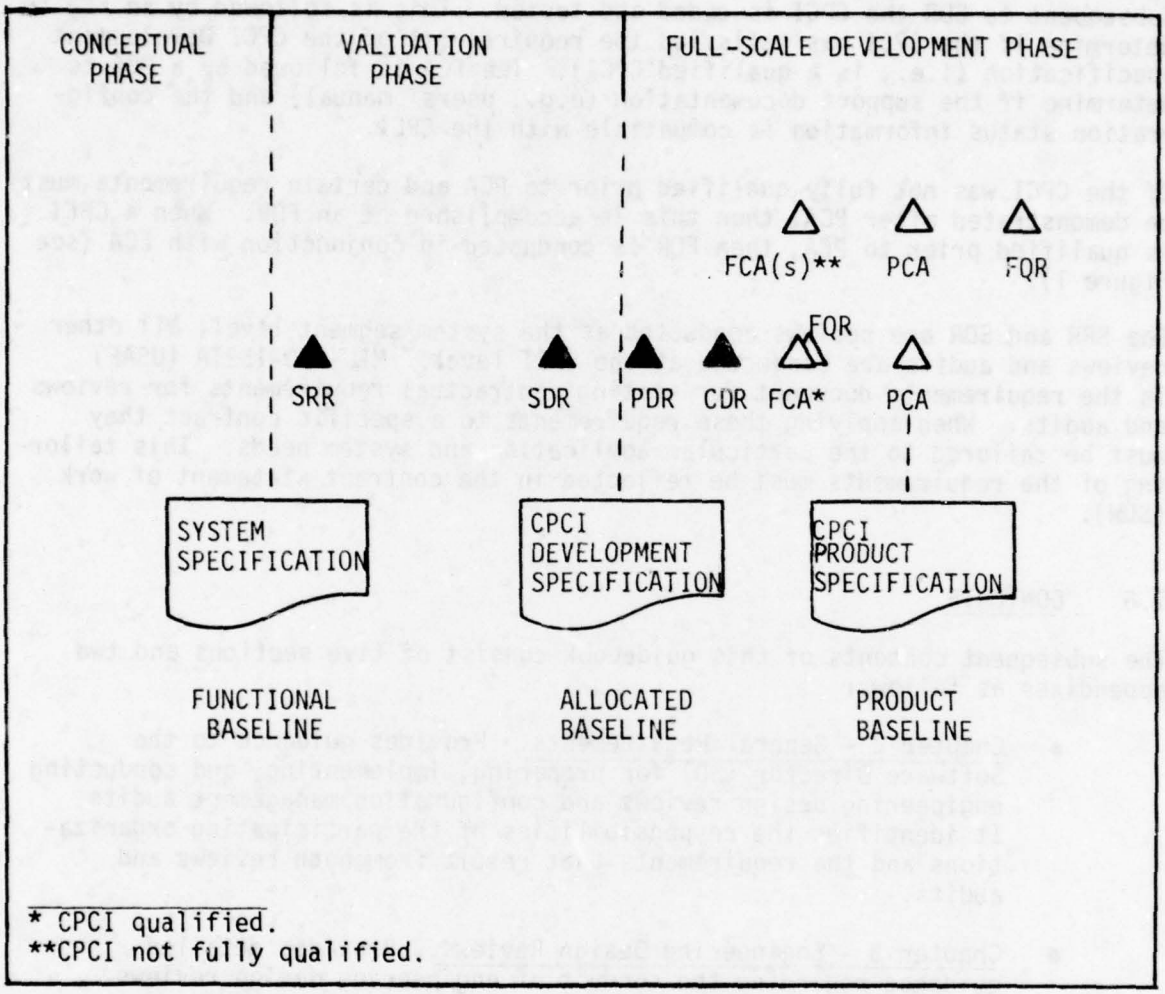

Figure 1. System/CPCI Reviews and Audits

During the Validation Phase the System Specification is the contract specification governing the developer's tasks. As the developer proceeds from the System Specification to detailing the requirements for each CPCI in a CPCI Development (Part I) Specification, the PO uses the SRR and SDR to monitor progress between the baselines (see Figure 1). The basic differences between the SRR and SDR is the level of technical detail available for review. The contract specification for Full-Scale Development is the CPCI Development (Part I) Specification and as the developer designs and develops the CPCI the PDR and CDR are used to monitor his progress. Again the difference between these two reviews is the level of detail available for review.

Subsequent to CDR the CPCI is coded and tested. This is followed by an FCA to determine if the CPCI has satisfied the requirements of the CPCI Development Specification (i.e., is a qualified CPCI). The FCA is followed by a PCA to determine if the support documentation (e.g., users' manual) and the configuration status information is compatible with the CPCI.

If the CPCI was not fully qualified prior to PCA and certain requirements must be demonstrated after PCA, then this is accomplished at an FQR. When a CPCI is qualified prior to PCA, then FQR is conducted in conjunction with FCA (see Figure 1).

The SRR and SDR are reviews conducted at the system/segment level; all other reviews and audits are conducted at the CPCI level. MIL-STD-1521A (USAF) is the requirements document for stating contractual requirements for reviews and audits. When applying these requirements to a specific contract they must be tailored to the particular application and system needs. This tailoring of the requirements must be reflected in the contract statement of work (SOW).

1.6 CONTENTS

The subsequent contents of this guidebook consist of five sections and two appendixes as follows:

- Chapter 2 - General Requirements. Provides guidance to the Software Director (SD) for preparing, implementing, and conducting engineering design reviews and configuration management audits. It identifies the responsibilities of the participating organizations and the requirements that result from both reviews and audits.

- Chapter 3 - Engineering Design Reviews. Provides detailed guidance regarding the conduct of engineering design reviews. It describes the purpose of each review, technical information and documentation to be evaluated, specific requirements for each review, and post review activities.

- Chapter 4 - Configuration Management Audits. Provides detailed guidance on conducting configuration management audits. It describes the purpose of each audit; identifies information, documentation, and products to be audited; and identifies post audit actions.

- Chapter 5 - FCA/FQR and PCA Sample Forms. Contains unofficial sample forms, taken for the most part from MIL-STD-1521A (USAF), that may be used to facilitate the collection of data at design reviews and audits.

- Chapter 6 - Reviews and Audits Problem Areas. Identifies some of the common and more serious problems associated with implementing and conducting engineering design and reviews and configuration management audits.

- Appendix A - Glossary. Defines terms and acronyms used in this guidebook.

- Appendix B - Bibliography. Provides list of regulations, specifications, and standards (RSS) that are particularly relevant to software reviews and audits.

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SECTION 2 - GENERAL REQUIREMENTS

The general requirements for reviews and audits are covered in Section 4 of MIL-STD-1521A(USAF). This guidebook assumes, as does MIL-STD-1521A (USAF), that an industry contract(s) is awarded for the Validation Phase and that the SRR and SDR are conducted to monitor the contractor's progress.

During the Validation Phase, engineering design reviews are conducted on the system/system segments to evaluate the CI definitions and to determine if system design compatibility has been maintained. During the Full-Scale Development Phase, engineering design reviews and configuration management audits are conducted on individual CIs including CPCIs.

Subsequent discussion in this section provides interpretation and guidance regarding general requirements as defined in MIL-STD-1521A (USAF).

2.1 LOCATION AND SCHEDULING

According to Paragraph 4.1.2 of MIL-STD-1521A (USAF), design reviews and audits are generally conducted at the contractor's facility. While this is normally true for hardware CIs, there may be exceptions for CPCIs. Support CPCIs, such as compilers, can usually be qualified and accepted at the development facility. For CPCIs directly associated with the operational mission (application programs), the CPCI will normally require operationally configured equipment for qualification purposes. The FQT and FCA are therefore normally conducted at the System Development Test and Evaluation (DT&E) site. PCAs should be accomplished at the development facility after successful completion of the FQT/FCA. When FQRs are conducted after PCA, they may be scheduled at the most convenient location, e.g., the System DT&E site. Otherwise the FQR should be scheduled in conjunction with FCA. The principal criterion for review-site selection should be assurance of the availability of the required information with minimum disruption of the development effort.

2.2 RESPONSIBILITIES OF PARTICIPATING ORGANIZATIONS

Paragraphs 4.1.3 and 4.2 of MIL-STD-1521A (USAF) identify both contractor and procuring activity requirements for supporting reviews and audits. It is important to note the difference in emphasis between reviews and audits. Reviews are primarily the responsibility of the developer to conduct with the PO playing a secondary role of questioning the technical information being presented. The primary responsibility for conducting audits is assigned to the PO with the developer providing the necessary support.

2.3 APPROVAL REQUIREMENTS

Approval requirements for engineering design reviews significantly differ from those related to configuration management audits. It is important to the contractor to successfully complete the contract milestones because his progress payments may depend upon their completion. However, the PO should avoid an indication of successful completion of a review or audit until convinced that the contractual requirements for a particular milestone have been satisfied.

2.3.1 Engineering Design Reviews

The purpose of a design review is to provide the PO with a way to monitor the contractor's technical progress; it is not to control it. The PO's responsibility is to participate in the design review and provide feedback to the contractor regarding his results. The PO may criticize the design, comment on its ability to meet performance requirements, or ask technical questions about the design. The PO should not, however, offer suggestions or guidance about how to modify the design; that is the contractor's domain and any design suggestions, even oral remarks, may be construed by the contractor to be guidance or direction which can result in a "constructive change" to the contract, at increased cost to the Air Force (see 6.1). As stated in Paragraph 4.2.4 of MIL-STD-1521A (USAF), "the procuring activity establishes the adequacy of the contractor's review performance by notification of:

- Approval--to indicate that the review was satisfactorily completed.
- Contingent Approval--to indicate that the review is not considered accomplished until the satisfactory completion of resultant action items.
- Disapproval--to indicate that the review was seriously inadequate."

2.3.2 Configuration Management Audits

Configuration management audits are performed to confirm that contractual requirements have been satisfied, thus requiring Government approval. For example, PCA for a CPCI provides for acceptance of the CPCI and upon successful completion the transfer of ownership from developer to the PO takes place. The PO will notify the contractor regarding the results of the audit, i.e., approval, contingent approval or disapproval. If the contractor is worried that his progress payments may be delayed for something other than "approval," the PO will normally get full cooperation in correcting any deficiencies.

2.4 CONDUCTING DESIGN REVIEWS AND AUDITS

Many problems are created, particularly at design reviews, if attendees focus only on the technical aspects of the review and are insensitive to contractual implications. The SD must recognize that he is not the technical manager of an in-house software development project and must therefore be extremely sensitive to the defined and agreed upon contractual relationships and responsibilities. The following list identifies potential problems:

- During Full-Scale Development, the contractor is required to satisfy the requirements of the CPCI Development (Part I) Specification by creating a design that will satisfy these requirements. During the PDR and CDR, the SD's responsibility is to determine if the design will meet the performance requirements. If the contractor's design does not do this, then the SD's function is to so inform the contractor and direct him to correct it. However, the SD should not dictate a specific design approach.

- During the Validation Phase, when contractors are involved in a competitive situation, any information given to one contractor at the SRR or SDR must be made available to the other contractors if the information impacts the competion. A contractor in a competitive situation cannot be given information which may give him an advantage over his competitors.

- The SD must be sensitive to the use of the word "approve" in the context of acquisition management. When the Government gives its approval on some aspect of the contract it is basically endorsing it. This approval may very well establish a shift in responsibility from contractor to Government, e.g., when the Government approves a contractor's specification, the Government becomes responsible for the contents and the contractor becomes responsible for implementing the specification. If approval is given to the design approach presented at PDR by the contractor, the contractor's responsibility is to implement that approved design, rather than satisfy the performance requirements of the CPCI Development Specification. This is why it is policy not to approve anything at design reviews other than the minutes. The approval of the minutes indicates that the review was satisfactorily completed.

- During configuration management audits the PO must assume responsibility for conducting the audit and the contractor provides support. Section 4 of MIL-STD-1521A(USAF) is somewhat misleading on this point because it lumps reviews and audits together. During the audits the PO verifies that the contractual requirements have been satisfied. The FCA and PCA are the prime instruments leading to "contractual acceptance" of the deliverable items. When the Air Force accepts each deliverable from the contractor, it indicates that the contractor has fulfilled his contractual obligations regarding that item; acceptance is final. If the contractor is allowed to take the lead role in audits, and there are deficiencies in the items to be delivered, he may attempt to cover up the deficiencies. Normally the Government will attempt to protect itself by having a "latent defects" clause specified in the contract. Latent defects are defects which exist at the time of acceptance but are not discoverable by a reasonable inspection. Once a latent defect has been identified it is the contractor's responsibility to correct the defect. In practice, it has proven difficult to establish that a latent defect did exist so the degree of protection offered by this clause is moot. CPCI acceptance is normally executed by signing the Form DD 250. At the time of signing, specific shortages should be listed. The contractor must correct these shortages prior to FQR. The corrections should be noted at FQR.

SECTION 3 - ENGINEERING DESIGN REVIEWS

Design reviews fall into two categories, system-level reviews and CI-level reviews, as follows:

- System-Level Reviews (SRR and SDR). During the Validation Phase the System/System Segment Specification is the contract baseline. The primary activity during this phase is system engineering; specifically, the system requirements are being refined and allocated to CIs. The purpose of the system-level reviews is to monitor the contractor's system engineering activities to determine if system integrity is being maintained and if CI definition is consistent and compatible with the system requirements.

- CI-Level Reviews (PDR and CDR). During the Full-Scale Development Phase the CI Development (Part I) Specification is the contract specification. The Development Specification defines the CI performance requirements and interfaces. In the case of CPCIs, the primary activity during this phase is the design and development of computer programs. The CPCI is designed and coded, using a CPCI Development Specification as the design-to requirement. The purpose of the CI-level reviews is to determine if the selected design is proceeding in a manner which is compatible with the CPCI Development Specification.

Each of these reviews is discussed in the following paragraphs in terms of (1) materials to be reviewed, (2) requirements, and (3) post-review activities.

The manner in which the system level reviews are conducted will depend on how the Validation Phase is being performed. If the Validation Phase is being performed by contractors, competitively, care must be exercised by PO personnel not to jeopardize the competitive situation. MIL-STD-1521A (USAF) does not distinguish between the competitive and non-competitive situation. It is best to check with procurement personnel regarding the treatment of competitive information for each program prior to conducting these reviews.

3.1 SYSTEM REQUIREMENTS REVIEW

The SRR is an in-process review, i.e., it can be conducted several times during the system life cycle. Normally, only one SRR is scheduled at the early stages of the Validation Phase activities. Appendix A of MIL-STD-1521A (USAF) assumes a series of SRRs and describes SRR requirements. These requirements must be examined and tailored to the needs of each program. If an SRR is scheduled at the early stages of the Validation Phase the majority of the items listed in Appendix A will not be available, e.g., (1) configuration management plan, (2) data management plan, (3) engineering integration. Figure 1, Engineering and Test Flow in MIL-STD-1521A (USAF), shows the SRR being conducted during the Conceptual Phase. The first sentence of Paragraph

10.1 in Appendix A states that SRRs are normally conducted during the system's Conceptual or Validation Phases. However, the remainder of Appendix A states requirements that can only be satisfied after the completion of the Conceptual Phase. Paragraph 10.2 of Appendix A states that, "The total system engineering management activity and its output shall be reviewed for responsiveness to the statement of work and system or system segment requirements". This can only be satisfied during the Validation Phase, and therefore SRRs should be scheduled starting in the Validation Phase.

The purpose of an SRR is to evaluate the progress and direction of the initial system engineering effort during the Validation Phase rather than to conduct an on-the-spot technical integration of the system. This review provides the PO with visibility regarding contractor performance within the scope of the Validation Phase contract.

Chapter 8, Paragraph 8-13, of AFSCP 800-3 states that "SRRs may result in technical or engineering management realignment to ensure that the contractor's initial technical interpretation of the contract is in line with program objectives." When applying this statement in a competitive situation, the PO must ensure that any realignment does not interfere with the competition. When in doubt, seek legal advice before proceeding.

3.1.1 Materials to be Reviewed

Since the SRR is normally conducted during the early stages of the Validation Phase, the PO should not expect complete formal documentation. The review should be conducted using preliminary documentation. These documents will normally be in the contractor's working paper format. If the SRR is delayed until formal documentation is available then the direction of the Validation Phase approach may be fixed and it may be too late to influence it. Appendix A of MIL-STD-1521A (USAF) provides a relatively exhaustive list of information to be reviewed at SRRs. However, it assumes that the requirements deal with a series of SRRs. For the initial SRR only a subset of this data may be available depending on when it is scheduled. For the initial SRR the following subset of contractor-produced data is normally reviewed:

- Mission and requirements analysis
- System-level functional flow analysis
- Preliminary requirements allocation to CIs
- System interface studies
- Initial trade studies

3.1.2 Requirements

The contracts awarded for the Validation Phase initiate contractor technical efforts to expand the total requirements of the system to the CPCI level. From this point, the system acquisition process proceeds on contractual schedules toward definition of the Allocated Baseline and associated plans which will scope and pace the total technical effort for the Full-Scale Development Phase. The basic purpose of conducting the SRR during the early stages of the Validation Phase is to determine if contractor efforts satisfy the tasks prescribed by the SOW, and to determine if the interpretations and detailing of the system requirements are compatible and consistent with the System Specification, rather than exceed or fall short of the stated requirements. This entails:

- Reviewing the initial trade studies performed by the contractor to see if they support the allocation of functional requirements to the CPCIs.
- Reviewing preliminary CPCI selection to assure the optimum selection for future development.

Trade Studies

To arrive at a preliminary selection of CIs and CPCIs, the contractor normally conducts initial trade studies. When contracting to a segment System Specification, the trade studies are confined to the boundaries of the segment on which the contractor is working. A system segment is a discrete package of system performance requirements, functional interfaces, and, eventually, CIs contracted to one contractor or assigned to one Government organization which is directly responsible to the procuring agency for that part of a system's performance. The reason for the statement "and, eventually CIs" is to indicate that at this point within the system acquisition life cycle the CIs have not yet been defined. The segment definitions are based on system engineering decisions made during the Conceptual Phase when the system requirements were apportioned into segment packages. The extent of the trade studies is dependent on the segment definitions. For example:

- If the segment contains both hardware and software, then the analysis and trade studies normally involve hardware, software, man/machine, and manual functions. The goal is to support the allocation of functions to these four areas and eventually to define the CIs for hardware and software.

- When the software is contained within a segment that does not include hardware, then the analysis and trade studies are restricted to software, man/machine, and manual functions.

Preliminary CI Selection

Although at SRR the CPCI selections are preliminary, the PO should pay particular attention to these selections and evaluate them in terms of their impact on future activities. Section 2 of the Configuration Management guidebook provides the rationale used in selecting CPCIs. Although the initial CPCI breakout is done on a technical basis, the final decision must be tempered by consideration of management and acquisition considerations. The PO should review the CPCI selections to determine:

- If they are at an appropriate level for management control purposes. The CPCI is the basis for management reporting against the WBS.

- Their impact on configuration management. How does the number of CPCIs affect the number of baselines, change processing requirements, configuration management status accounting, and reporting? Normally these are organized by CPCI and the initial definitions should be examined to determine their effect on the costs of conducting configuration management.

- Their impact on data management, i.e., data selection and data costs. Each CPCI has its own support data packages. For example, for each CPCI, there is a Development Specification; Product Specification; test plan, procedures, and reports; users manuals; and version description documents.

- Their test management implications. The early phase of DT&E are directed to CPCI-level testing and are the responsibility of the developer. CPCI selection has an impact on test planning activities and test responsibilities.

- Their impact on engineering management. The definition of a CPCI identifies an integrated design package to be designed, reviewed, and developed during the Full-Scale Development contract.

- Their impact on CPCI delivery and integration. A CPCI identifies the level of delivery for the product, i.e., acceptance is accomplished at the CPCI level. The CPCI definition defines the requirements for each design package that will be delivered and integrated with the other CIs. Naturally this definition establishes development and integration responsibilities that will eventually be reflected in the Full-Scale Development contract.

Many acquisition problems are created if CPCI definitions are only viewed technically. A common misconception is that more CIs will provide more control and visibility. In fact, when many CPCIs are defined, costs are increased (increased data, management reviews, and control and configuration management requirements), the PO accepts more responsibility (an increase in the number of Development Specifications, each with interfaces that must be approved by the Government when the specification is baselined), and the visibility remains essentially the same (the Development Specification requirements must still be defined at the performance level). Multiple CPCIs result in:

- Instead of one CPCI Development Specification, the CPCI requirements are contained in several. The level of control, when baselined, is still performance requirements.

- Each Development Specification has added interfaces, i.e., interfaces between CPCIs. When the Allocated Baseline for each CPCI is established, the PO accepts responsibility for these interfaces. The contractor's responsibility is to implement the requirements for each specification.

- The configuration management activity now has to control more baselines and more sets of configuration control and reporting records.

- The support data package will contain a substantial increase in the number of documents, i.e., each CPCI will have a test plan, test procedures, and test reports, in addition to a CPCI Product Specification.

- At the PDRs, the design approach for each CPCI is presented. Whether the design of all the CPCIs is compatible is now the PO's concern.

- At the time of delivery the contractor delivers multiple CPCIs with data packages. The PO now has to arrange to have them integrated, which the developer may be contracted to perform after he satisfies his responsibility to the CPCI Development Specifications.

3.1.3 Post-Review Activities

At the completion of the SRR, the contractor will draft the minutes and have them reviewed and approved by the co-chairmen. The minutes are prepared in accordance with DI-E-3118. Normally this DID is a contract data requirement specifying that the minutes are to be supplied by the contractor. Approval of the minutes indicates that they accurately reflect the results of the meeting. The last section of the minutes, "Problem Study Areas," provides an identification of each problem/deficiency found. Each problem identified for post-review action should be assigned an action item number, a responsible organzation, and a suspense date. Each problem should be tracked, and proposed solutions reviewed by the PO. If the PO deems the solution inadequate, the action item should remain open until a satisfactory solution is developed.

3.2 SYSTEM DESIGN REVIEW

The SDR is conducted during the Validation Phase before the developer submits his Validation Phase products. The purpose of the SDR is to allow the PO to evaluate the adequacy of these products prior to submission. For systems with no scheduled Validation Phase, an SDR should be scheduled during the early stages of the Full-Scale Development Phase. Even when there is no Validation Phase, the CPCI Development Specifications are still required, and the activities normally conducted during the Validation Phase are scheduled during the early stages of the Full-Scale Development Phase. Appendix B of MIL-STD-1521A (USAF) identifies requirements for the SDR.

3.2.1 Materials to be Reviewed

The SDR for the software portions of system segments should include a review of the following materials:

- Preliminary Development Specification for each CPCI (DI-E-3119A)
- Updating information for the System/Segment Specification (DI-E-3101)
- Trade studies (DI-S-3606)
- Quantitative and Qualitative Personnel Requirements Information - QQPRI (DI-H-3253)
- Computer Program Development Plan-CPDP [DI-S-30567]
- Test planning information (DI-T-3703)
- Operator procedures and task analysis report (DI-H-3268A)
- Exercise capability implementation information (DI-H-3270A)
- Recommendations for equipment, facilities, and communications (usually documented as an integral part of the technical proposal)

3.2.2 Requirements

The basic requirement of the SDR is to evaluate the contractor's progress just prior to the formal submission of Validation Phase products. It is essential that the documentation reviewed at SDR be critically examined to assure attainment of the objectives of the Validation Phase. The contract specification during the Validation Phase should be either the System or a Segment Specification. The developer's task is to detail the requirements and allocate them to CPCIs. For each CPCI a Development Specification will be generated along with a proposal for conducting a Full-Scale Development Phase contract. The PO will participate in the SDR, normally supported by the General System Engineering/Technical Director (GSE/TD) contractor*. the PO's objectives are to determine (1) that the requirements for each system element are essential and reflect the requirements of the System Specification, (2) that the system definition presents an optimum balance of system elements, and (3) that a technical understanding has been reached. Specifically, the review should include evaluation of the following data:

- Trade Studies. The contractor shall accomplish the trade studies specifically directed by the Validation Phase contract which are to provide technical substantiation of requirements for CPCIs, equipment, personnel, and training. The trade studies shall consider the availability of current computer programs, computing equipment (either within the Government inventory or commercially available), personnel with necessary skills, and existing training programs. The objective of these trade studies is to achieve a system balance based on the consideration of total requirements. The results will be documented in accordance with DI-S-3606. There is no standard set of criteria for evaluating trade studies as the criteria depend on the needs of each specific system. The trade study conclusions should identify the rationale for:
  - Allocation of functions to CPCIs.
  - Assignment of manual functions.
  - Allocation of requirements to hardware.
  - Man/machine decisions, including display format and contents, push-button allocation and assignment, and report formats and contents.
  - Alternate information flow.
  - Sizing and timing conclusions.

*The mission of the GSE/TD contractor is defined in AFSCP 800-3, paragraph 20-11, page 20-10.

For each trade study, the PO should assure that:

- Trade study objectives are identified.
- Justification for parameters and weighting factors is presented.
- All requirements and constraints are identified.
- All results were logically derived.
- Total system implications were considered.
- Alternative approaches were objectively considered and evaluated.
- The selected set of requirements meets rather than exceeds requirements.
- Any requirements imposed on the system by the trade studies are properly communicated.

- System Engineering Documentation.
  - Functional allocation, including computer program functions, operator functions, and man/machine functions.
  - Operator task analysis.
  - Training and evaluation needs analysis.
  - System exercising capability implementation plan.
  - Built-in simulation and test capabilities.
  - Data reduction capabilities.
  - Computer program development tools.
  - Computer Program Development Plan.
  - Personnel requirements, including operational requirements, computer program support requirements, and simulation/exercising personnel requirements.
  - Recommended design requirements for equipment, communications, and facilities.
  - CPCI Development (Part I) Specifications, including operational requirements, support requirements, and utility requirements.
  - System Specification inputs, including a list of CPCIs and Functional allocations.

In evaluating the system engineering documentation, the PO should assure that:

- The CPCI selection was accomplished using the rationale and criteria defined in Section 2 of the Configuration Management guidebook.
- The operator task analysis results are compatible with the operator interface requirements of the CPCI Development Specifications, i.e., keyboard actions and display requirements.
- The duty positions and associated operator qualifications are identified.
- The training requirements have been identified for operational and support personnel.
- An adequate test program has been established for the CPCI(s).

The system exercising capability has been reviewed to identify the following:

- System elements(s) to be exercised.
- System personnel to be exercised.
- Required exercising capability elements(s).
- Required exercising personnel.
- The training/evaluation needs to be satisfied.

In evaluating each CPCI Development Specification, the PO should assure that:

- The Development Specification(s) contain performance requirements rather than computer program design information, i.e., a non-programmer can evaluate the Development Specification. Personnel with air defense knowledge should be able to evaluate a Development Specification for an air defense application CPCI since it describes air defense requirements, not computer program design requirements.
- The Operational CPCI Development Specification reflects an understanding of the operational mission (see Requirements Specification guidebook).
- The requirements are defined at a level of detail sufficient to initiate the CPCI design effort.

- The CPCI functional flow charts integrate the CPCI functions and define the relationship of the functions to the CPCI external interfaces.

- Interface block diagrams identify the interfaces between the CPCI and its immediate operating environment.

- The CPCI requirements are compatible and traceable to the System Specifications.

- The CPCI interfaces are identified and detailed in terms of specific message format, contents, and timing requirements.

- The explanations for "not applicable" or "to be determined" entries in the Development Specifications are justified.

- Only necessary design constraints are specified.

- The display requirements are defined in terms of display formats, contents, timing, and priorities.

- The requirements for numbers, positions, labels, and functions of operator input devices are specified, e.g., push-button layout of operator console.

- The following information is available relative to displays:
  a. Formats to be used in presenting information
  b. Conventions and symbols to be employed in presenting information details
  c. Rules for routing displays
  d. Rules for forcing displays
  e. Rules for updating displays
  f. Rules for priority handling of displays

- Manual input device information is identified, including:
  a. Allocation of the types of information to be inserted at each manual input device.
  b. Frequencies of operator insertion readout by computer program.
  c. Specific details of each action to be available for keyboard type devices.

d. Rules for feedback to inform operating personnel of the adequacy of their insertions.

- The data base requirements are specified in terms of units of measure, range of possible values, precision, and accuracy of requirements.

- All requirements in Section 3 of the Development Specification are accounted for in Section 4.

- All applicable documents listed in Section 2 are referenced in Section 3 requirements.

This list should be used to augment the requirements in Appendix B of MIL-STD-1521A (USAF).

In reviewing the contractor's proposed updates of the System Specification, the PO should assure that:

- The updates are compatible with the segment requirements.

- There is traceability between the segment requirements and the defined CPCIs.

- The functional interfaces with the other segments have been detailed.

- The expansion has provided additional detail to clarify and amplify basic requirements, rather than change them.

- Any changes to the system requirements have been identified.

3.2.3 Post-Review Activities

Any deficiencies identified during the SDR should be noted in the SDR minutes. The contractor should correct the deficiencies prior to submitting the Validation Phase products. The PO should review the SDR minutes, during final evaluation of the submitted products, to identify outstanding problems and to determine if they have been solved in the delivered products.

3.3 PRELIMINARY DESIGN REVIEW

The PDR is a formal design review conducted during the Full-Scale Development Phase. Prior to PDR, the CPCI Development Specification should have been authenticated and baselined. The PDR is a review of the developer's top-level CPCI design in response to the approved performance requirements (CPCI Development Specification). The purpose of the PDR is to determine if

(1) the design approach takes into account all performance requirements, (2) the design approach will satisfy the performance requirements, and (3) the CPCI being reviewed is functionally compatible (interfaces) with the other CIs. The requirements for conducting a PDR are specified in Appendix C of MIL-STD-1521A (USAF). These requirements, when placed on contract, should be tailored to the specific needs of the system/CPCI.

3.3.1 Materials to be Reviewed

The specific technical information to be reviewed and the details concerning actions to be accomplished at a given PDR are normally determined by the contractor and the PO when the agenda for the review is established. The material to be reviewed normally includes:

- Updated CPCI Development Specification(s)
- Storage allocation charts
- CPCI functional flows
- Functional design description of executive control and start/recovery elements
- CPCI design and control structure
- Structure and organization of the data base
- Interface requirements
- Design trade studies
- ECP status
- Computer Program Development Plan
- CPCI test plan
- Development support requirements
- Development tools

3.3.2 Requirements

A PDR is normally held within 60 to 90 days after the start of the Full-Scale Development Phase. Only one PDR is required to be successfully accomplished for each CI. For internal management purposes, contractors may elect to perform additional design reviews as they deem necessary; however, formal notification, participation, and acknowledgment by the PO is not required.

The PDR shall be accomplished when the basic design approach has been selected by the contractor. Normally PDRs are accomplished at the contractor's facility where the design is in progress. The design approach presented at the PDR should be based on an approved set of performance requirements contained in

the baselined CPCI Development (Part I) Specification. It is extremely important that the Development Specification be established as the Allocated Baseline prior to initiating the CPCI design approach. The requirements in MIL-STD-1521A (USAF) assume that the system life cycle includes a Validation Phase. Systems not having a Validation Phase require a significant tailoring of the requirements. The basic tasks, normally accomplished within a Validation Phase, are not scheduled in the early stages of Full-Scale Development. When faced with this situation it is important that the CPCI Development Specification be approved and baselined prior to PDR. Some system acquisitions have experienced problems when the approval of the Development Specification was accomplished during PDR. When this happens the developer has to create a design based on unapproved requirements. This results in the developer presenting both the Development Specification and a design approach at PDR. If the requirements within the specification are altered as a result of evaluation and approval this may have an impact on the design presented at PDR. Depending on the magnitude of the changes there may be a severe impact on schedules.

The PDR for CPCIs is accomplished by reviewing the following:

- Development Specifications. The version of the Development Specification baselined at the end of the Validation Phase normally will contain several "To Be Determined" (TBD) statements. During a competitive Validation Phase, many interfaces are not known until after source selection at the end of the phase. All TBDs should be removed prior to the end of PDR.

- Storage Allocation Charts. These charts describe the manner in which various elements of the CPCI have been allocated to available computer storage. In cases where the system does not have fixed storage a review of the algorithims used to determine storage should be accomplished. The intent of this part of the review is to ensure the compatibility between the CPCI and available computer storage.

- CPCI Functional Flows. The CPCI functional flow summarizes the flow of information for the complete CPCI and identifies the Computer Program Components (CPCs), their relationship within the CPCI, and with the CPCI's external interfaces. These charts provide an overview of tasks to be performed by the CPCI and can be related to the performance requirements in the Development Specification.

- Structure and Organization of Data Base. This is a description of the structural layout and the allocation of storage requirements of the CPCI data base, identifying the types and characteristics of data.

- Interface Requirements. Although these were identified in the CPCI Development Specification and approved, it is important that they be reviewed again at this time. Interface requirements include such things as definitions of word length, message formats, available computer storage, and timing considerations.

- Design Trade Studies. This information was developed as a result of studying alternate design methods and techniques.

- ECP Status. Review the configuration management accounting records to determine which approved ECPs should be reflected in the design presented at PDR and to ensure that they are included.

- CPDP. The CPDP was originally generated during the Validation Phase. A design approach should have been presented in the CPDP. The design approach presented at PDR may differ from the one described in the CPDP. The CPDP should be reviewed to determine if it requires updating to make it compatible with current design and development approaches.

- Test Plan. The initial test plan was submitted as one of the Validation Phase products. At PDR it should be updated to reflect any changes resulting from the design.

- Support Tools. Requirements for tools to support the CPCI development should be reviewed for their adequacy and to determine which ones should be required to support the CPCI during deployment.

The PO should assure that:

- TBDs in the CPCI Development Specification are removed and that the required information is now available and adequate.

- There is compatibility between the CPCI and the other CIs.

- There is traceability between the requirements in the development specification and the design approach.

- All ECPs approved since establishing the allocated baseline are reflected in the PDR design information.

- The planned sequence of operations for the CPCs is compatible with the requirements of the Development Specification.
- The CPCI timing and storage requirements are consistent with the system and equipment constraints.
- The design constraints, stated in the Development Specification have been incorporated into the design approach.
- The executive control design satisfies the needs of the CPCI.
- Design considerations have been made to accommodate adaptation data for multi-site systems.
- Startover/recovery features meet their performance requirements.
- Design trade studies have been accomplished and are reflected in the selection of the design approach.
- The required storage has been allocated to the CPCs and the data base.
- The contractor either has or is developing any required special tools needed to support his design and development effort.
- There is a requirement to deliver/qualify the support tools.
- Any differences in configuration between the development facility and the operational equipment configuration are identified.
- The contractor has adequate plans to accommodate any identified differences in configuration.

3.3.3 Post-Review Activities

The PO has several decisions that may be made as a result of the review, including:

- Unqualified approval to specify complete agreement between and among the reviewing team and the developer.
- Approval with contingent action items when the review is not considered accomplished until satisfactory completion of actions.

- Approval with deviations when it is in the interest of the program to award limited approval and protect program schedules pending completion of further engineering as indicated by actions assigned in the minutes.

- Disapproval when the subject of the review is unsatisfactory or generally inadequate. The review must be rescheduled as a result of the disapproval.

The contractor will prepare and submit the PDR minutes, normally within 5 working days after completion of the review. The PO's approval of the minutes indicates that the minutes accurately record the actions taken at the review meeting. The PO approval of the minutes does not indicate approval of the design presented. When the minutes identify problem areas and action items, the PO should assign action item numbers to each and assign personnel to monitor the action items.

If any changes to the established baselines are required as a result of the PDR, the PO should assure that the necessary ECP action is initiated. Normally, some change requirements are identified at PDR and ECP activities should be expected.

The Configuration Management Division should take the necessary action to update the Allocated Baseline to reflect the updated CPCI Development Specification.

3.4 CRITICAL DESIGN REVIEW

Upon completion of the PDR the developer initiates the detailed design of the CPCs. The CDR (or series of CDRs) for a CPCI is a technical review accomplished when logical design is completed at the level of flow charts (or equivalent), prior to coding and testing. When a complex CPCI is scheduled to reach any given stage of the design/development/test process in increments of CPCs or assemblies of CPCs, the CDR is also scheduled in increments, and the actual level of design at which reviews are scheduled may be adjusted to optimize the efficiency of the overall CDR for the CPCI as a whole. Compared with the PDR, the CDR provides a more detailed basis for verifying design integrity and compatibility with the CPCI Development Specification. The primary purpose of the CDR is to establish the accomplished design and development as the basis for continuation of CPCI development.

Some coding may be accomplished prior to CDR. This is particularly true in areas where the requirements are straightforward, where the developer feels that coding is necessary to assure that the program design is feasible, or when certain long lead time modules are required. When the developer commits design to coding, prior to CDR, he naturally accepts responsibility for the decision. When this occurs, and changes are required as a result of the CDR, the developer will be required to make the necessary adjustments. The requirements for conducting a CDR are specified in Appendix D of MIL-STD-1521A (USAF).

3.4.1 Materials to be Reviewed

The actual details of the CDR will be initially defined in the contract SOW. The data required for CDR will be specified in the CDRL. The agenda for the review will consolidate and detail this information. The developer will prepare the agenda and submit it to the PO for approval. Basically the technical information presented at the CDR is the same data contained in a CPCI Product (Part II) Specification, with the exception of the program listings and the results of software engineering studies that were conducted to arrive at the CPC-design decisions (e.g., design trade studies and analyses).

Trade studies are accomplished at all levels from system to detailed design. The most significant trade studies are accomplished during the early phases of the system acquisition life-cycle. By CDR, the majority of trade studies have been completed. The trade studies accomplished at this time are done by the programmers as they work out the design of the CPCs.

3.4.2 Requirements

The purpose of the CDR is to critically review the detailed design of the CPCI (e.g., flow diagrams, data, data structure, and prose descriptions) to determine if:

- The requirements of the CPCI Development Specification can be implemented.
- The detailed design is compatible with the design structure presented at the PDR.
- The detail is sufficient to initiate coding.

The PO must bear in mind that the contractor is responsible for the design of the CPCI until he demonstrates that the design satisfies the requirements of his contract specification [CPCI Development (Part I) Specification]. The PO should not insist on any particular design for the contractor to follow. If a specific design is required, it should be so stated in the Development Specification as a design contraint to be implemented by the contractor. The PO can require corrective action if the contractor shows a lack of effective

technical management capability or insufficient technical capability. The kinds of corrective action that the PO can take are (1) unqualified approval, (2) approval with contingent action items, (3) approval with deviations, or (4) disapproval (see Paragraph 3.3.3).

Normally design reviews are conducted by having the contractor present his design and the rationale used in arriving at his design decisions. The PO's role is to question the design presented in an attempt to identify deficiencies. If the deficiencies are extensive, the PO may find the design technically unacceptable and may reschedule the CDR for a later date. If the basic design is found to be technically sound, the deficiencies can be listed in the minutes of the CDR and follow-up action can be taken to determine if the deficiencies were corrected.

In evaluating the contractor's design, the PO should assure that:

- All outstanding deficiencies identified at PDR have been corrected.
- The requirements in the Development Specification are current and reflect approved ECPs.
- The contractor provides information to demonstrate that the sizing and timing requirements can be satisfied.
- The interfaces between the CPCs are identified and compatible.
- All requirements in the CPCI Development Specification can be identified in specific portions of the detailed design.
- The relationship between the CPCs and the data base elements is identifiable.
- The external CPCI interfaces are compatible with those stated in the Development Specification.
- The design constraints specified in the Development Specification have been implemented.
- The design implements the established programming standards established in Section 3.2 of the Development Specification.
- The test plan and procedures have been updated to reflect changes due to approved ECPs.

- The test plan is compatible with Section 4 of the Development Specification.

- The test procedures will adequately demonstrate the performance capabilities of the CPCI.

3.4.3 Post-Review Action

The contractor will publish the CDR minutes, normally within 5 working days of the completion of CDR. Discrepancies, identified during the course of the review, will be reflected in the minutes along with a schedule for their correction. The PO should initiate follow-up action to assure that the discrepancies are corrected.

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SECTION 4 - CONFIGURATION MANAGEMENT AUDITS

The purpose of configuration management audits is to verify compliance with requirements. As stated in AFSCP 800-3, compliance with specification and other contract requirements is verified by means of configuration audits. The audits function validates accomplishment of development requirements and achievement of a product configuration through the CI's technical documentation. Two kinds of audits are performed, functional and physical. The Functional Configuration Audit (FCA) verifies that the CPCI performance satisfies the requirements of the CPCI Development Specification. The Physical Configuration Audit (PCA), on the other hand, verifies that the technical documentation is compatible with the CPCI that has successfully passed FCA. There is a shift in responsibility from conducting design reviews to conducting audits. In both cases, a joint PO/developer team is involved. For the design reviews the co-chairman with primary responsibility represents the developer. For audits the co-chairman with primary responsibility represents the PO. PO representation at the reviews is normally from the System Engineering Office, while PO representation at the audits is normally from the Configuration Management Office. The official documents stating the requirements for conducting audits are:

- Air Force In-house Direction. Chapter 5 of AFR 65-3.
- Contractual Requirements. Appendixes E, F, and G of MIL-STD-1521A (USAF).
- Additional Information. Chapter 5 of AFSCM/AFLCM 375-7 and Chapter 9 of AFSCP 800-3 (guidance for conducting FQRs is also addressed in this chapter).

Both the FCA and the PCA are discussed in the following paragraphs in terms of (1) materials to be reviewed, (2) requirements, and (3) post-review activities.

4.1 FUNCTIONAL CONFIGURATION AUDIT

The basic purpose of the FCA is to determine if the CPCI has satisfied the requirements of the CPCI Development Specification. This is accomplished by auditing the results of the CPCI qualification tests to determine the qualification status of the CPCI. When a CPCI test program has Preliminary Qualification Tests (PQTs) and a Formal Qualification Test (FQT), the FCA may begin in increments with the PQTs; however the FCA cannot be considered complete until FQT has been accomplished. The management and control of the test program along with the evaluation of the test results are the responsibility of the Test Division; Configuration Management is responsible for auditing the results. Appendix E of MIL-STD-1521A (USAF) provides the requirements for conducting FCAs.

4.1.1 Materials to be Reviewed

The materials normally reviewed at FCA include:

- CPCI Development (Part I) Specification
- Final draft CPCI Product (Part II) Specification
- CPCI test plan
- CPCI test procedures
- CPCI test reports of all formal tests completed
- PDR and CDR Minutes
- Configuration management status reports
- List of qualification tests yet to be accomplished

4.1.2 FCA Requirements

In conducting the FCA, the PO should:

- Review the configuration status records to determine the implementation status of all approved ECPs.
- Review the Development Specification to determine if it has been updated to reflect approved ECPs, including both Sections 3 and 4.
- Assure that there is a test procedure and test report for each CPCI qualification test identified in the test plan. This requirement will only exist if called for in the CDRL. If qualification of certain functions was to be accomplished during Computer Program Test and Evaluation (CPT&E), determine if the contractor has delivered the test data, if it has been evaluated, and if it was sufficient to qualify the specified functions.
- Determine which functions, if any, were to be qualified during PQTs (as stated in Section 4 of the Development Specification) and determine if the requirements were satisfied.
- Determine if the functions that failed to qualify during the PQT were satisfied during FQT.
- Assure that the FQT results were documented, evaluated, and found to have satisfied the requirements.

When a CPCI fails to meet requirements there are several items that must be considered prior to deciding on a course of action.

- How critical are the areas that have not qualified?
- What impact would the non-qualified areas have on the conduct of System DT&E?
- What schedule and cost impact, if any, will delaying the CPCI have on System DT&E?
- How is the contractor held responsible for the unqualified requirements?

The courses of action available to the PO, which will be formally communicated to the developer, are:

- Unqualified approval which indicates that the CPCI has satisfied the performance requirements and that the FCA has been successfully completed.
- Approval with contingent action items when the audit is not considered accomplished until satisfactory completion of the actions. Normally these action items must be completed prior to PCA.
- Approval with deviations when it is in the interest of the program to authorize limited approval and protect program schedules. In this case the PO may plan to proceed with PCA and to have the developer correct the deviations after PCA and to audit their accomplishment during FQR.
- Disapproval when the audit is unsatisfactory or when contractual requirements have not been satisfied. Normally this action will require modifications to the design and a rescheduling of qualification testing and the FCA.

On occasions, the requirements in the Development Specification may be too stringent and it may be desirable to change the specifications to agree with CPCI performance.

4.1.3 Post-Audit Action

Normally, within 5 working days, the contractor will document the minutes of the FCA. The PO Configuration Manager will officially record the results of the FCA for the purpose of communicating the results to the Procuring Contracting Officer (PCO). Requirements not scheduled for qualification until after FCA should be listed on a DD Form 250 and presented at PCA. These requirements should be reviewed and audited at FQR.

4.2 PHYSICAL CONFIGURATION AUDITS

The PCA, like the FCA, is a configuration management audit. At the FCA, it was determined that the CPCI performed in accordance with the requirements in the CPCI Development (Part I) Specification. The objective of the PCA is to determine if the support documentation (i.e., Product Specification, manuals, and handbooks) accurately reflects and is compatible with the qualified CPCI. The PCA is normally held after completion of FQR and FCA. As a result of the PCA, recommendations are made to the responsible contract administration office whether or not to accept the CPCI. When conducting a PCA, the audit team members must be aware of the important role that the CPCI Product (Part II) Specification plays during Deployment. This specification provides a technical description of the qualified CPCI, i.e., it identifies the exact configuration of the qualified CPCI. It is the prime instrument used for making design modifications (software maintenance) to the CPCI. The Product Specification provides the technical description of the qualified CPCI. It is therefore critical that the Product Specification accurately describes the CPCI. Appendix F of MIL-STD-1521A (USAF) identifies the requirements for conducting PCAs.

4.2.1 Materials to be Reviewed

The actual list of materials to be reviewed at the PCA is identified when the PCA agenda is approved. Normally, these materials include:

- CPCI Development (Part I) Specification
- Final draft of the CPCI Product (Part II) Specification
- Version description document
- Manuscript copy of positional handbook
- Manuscript of computer programming manual
- Manuscript of computer program user's manual
- FCA minutes
- Configuration index
- Configuration status report

- CPCI development record
- Proposed DD Form 250 (including shortage list)
- List of changes to the CPCI made during qualification testing

See the Software Documentation Requirements guidebook for descriptions of the documents listed.

In addition to the above listed materials the following identification information, for the items to be accepted, should be available.

- Nomenclature
- Specification identification number
- CPCI identifiers
- Code identification number (H4-1 Number)

4.2.2 Requirements

The PCA for a CPCI is focused on the Product Specification and the support documentation package that describes the specific version of the qualified CPCI. In implementing the requirements of Appendix F of MIL-STD-1521A (USAF), the SD must clearly understand the differences between hardware and software PCAs. These differences are not always apparent in military specifications and standards. The basic differences are as follows:

- The Hardware PCA is conducted on the first production article to determine if the Production Specification/drawings accurately describe the production unit. The hardware PCA supports a major decision regarding production go-ahead.

- The Software PCA, on the other hand, is a comparison of the Product Specification and the support documentation package with the qualified CPCI (a development article). A successful PCA for a CPCI is a major milestone for determining whether Full-Scale Development contract products should be accepted.

Performing the PCA on a CPCI is a technically difficult and tedious task because of the intricacy and volume of details. The PCA is conducted by comparing the documentation, including the listings, with the qualified CPCI. Visibility (inspection) is provided by the listings. In theory, the steps are:

- Verify source code printouts used to assemble or compile the master tape against the Product Specification.

- Through detailed technical analysis, verify the narrative information and flowcharts against the listings, for:

- Accuracy
- Completeness
- Understandability

Software tools can be used to aid the SD in conducting a PCA. These tools can be used to generate documentation from the qualified CPCI. Examples of such tools are flow charts generated by automated flow-charter software packages, set-used matrixes, and COMPOOL outputs (see Appendix A of the Verification guidebook for a description of these tools).

The documentation generated in using these tools should be compared to the delivered documentation to determine its accuracy. In addition to making the comparisons, the SD should assure that:

- The delivered documents satisfy the format and contents specified in the Data Item Description (DID) and are responsive to the CDRL.
- The CPCI Product (Part II) Specification is accurate, complete, and compatible with the CPCI.
- The CPCI Development (Part I) Specification has been maintained to reflect all approved ECPs.
- The configuration management status accounting records provide complete traceability and document the status of ECPs and the CPCI configuration.
- The version description document accurately describes the delivered version of the CPCI.
- The CPCI Product Specification reflects the currently approved configuration of the CPCI.
- The user/operator manuals have been validated.*

*The positional handbooks, user manuals, and operator manuals should be validated prior to System DT&E. The verification of these manuals will normally be accomplished during System DT&E. The definitions for validation and verification used herein are in accordance with AFR 8-2, i.e.:

- Validation is the process by which the contractor tests operating and maintenance procedures for technical accuracy and adequacy.
- Verification is the process by which operating and maintenance procedures are tested and proven under Air Force jurisdiction.

- The user/operator manuals reflect the latest approved ECPs.
- The positional handbooks are compatible with the latest approved CPCI configuration.
- The positional handbooks have been validated by the contractor.*
- The problems and deficiencies identified in the minutes of the reviews and audits have been corrected.
- The development record is complete (part of the CPCI configuration index).
- The documentation package is compatible with the computer program configuration index.
- The actual CPCI is in conformance with Section 5 of the Development Specification or the SOW.**
- All the authorized shortages (e.g., interface requirements to be demonstrated during System DT&E) and associated make-up schedules are identified in the DD Form 250.
- CPCI Subsystem DT&E plans, procedures, and reports are complete and have been approved.

* The positional handbooks, user manuals, and operator manuals should be validated prior to System DT&E. The verification of these manuals will normally be accomplished during System DT&E. The definitions for validation and verification used herein are in accordance with AFR 8-2, i.e.:

  - Validation is the process by which the contractor tests operating and maintenance procedures for technical accuracy and adequacy.
  - Verification is the process by which operating and maintenance procedures are tested and proven under Air Force jurisdiction.

**MIL-STD-1521A (USAF) relates this information to Section 5 of the Product Specification rather than the Development Specification. This is true for a hardware CI. However, for a CPCI, the Product Specification is a technical description of the CPCI and not a contractual specification. Any requirements for the "Preparation for Delivery" of a CPCI must be identified in the Development Specification or the SOW to make them contractually binding.

4.2.3 Post-Audit Actions

The contractor will publish the PCA minutes, normally within 5 working days after completion of the PCA.

The PO notifies both the contractor and the PCO of any post-audit action, normally within 10 working days of the receipt of the PCA minutes.

The PCO will sign the DD Form 250 indicating contractual acceptance of the CPCI and related products. If the DD Form 250 has shortages listed, then the signed DD 250 represents a conditional acceptance until the shortages have been satisfied. When test and evaluation results are a condition of acceptance and are not available prior to PCA, the following note is normally extended if conditional acceptance is made by the PO:

> *"Acceptance and payments are contingent upon receipt of approved test and evaluation results."* A conditional acceptance, with outstanding qualification requirements, normally requires an FQR.

4.3 FORMAL QUALIFICATION REVIEW

The FQR is that milestone within the system acquisition life cycle when the Government officially certifies that the CPCI is qualified. The actual scheduling of the FQR will depend on the System/CPCI. If a CPCI can be qualified at FCA then the FQR will be scheduled as part of FCA. If a CPCI has requirements yet to be satisfied at the time the PCA is conducted, then an FQR will be scheduled and conducted after PCA, normally during System DT&E.

The requirements for the conduct of the FQR, the materials to be reviewed, and the post-review actions are essentially the same as those for FCA. Appendix G of MIL-STD-1521A (USAF) specifies the requirements for conducting an FQR.

SECTION 5 - FCA/FQR AND PCA SAMPLE FORMS

This section contains modified sample forms from MIL-STD-1521A (USAF) that may be used in conjunction with design reviews and configuration management audits. These are not official forms but are presented as a recommended way of identifying and recording critical data.

5.1 ACTION ITEM FORM

The Action Item Form is used by the PO to further define the action items identified in the minutes of the reviews/audits and to assign a control number and responsible individual to track and monitor the action. The responsible individual will report the status of the action item and will coordinate the approval of the end result. For each action item identified in the minutes an action item form will be initiated. The Action Item Form is illustrated in Figure 2.

5.2 CERTIFICATION ATTACHMENT FOR FCA/FQR

The Certification attachment for FCA/FQR is used to record the necessary data leading up to the qualification and certification of a CI. This record is developed during FCA and is finalized when the FQR is conducted. The forms are completed by the FCA and FQR team members and are illustrated in Figure 3.

5.3 CERTIFICATION ATTACHMENT FOR PCA

The certification attachment for the PCA is used by the PCA team to establish records during PCA. The sample format for the PCA certification is illustrated in Figure 4.

ACTION ITEM

CONTROL NO. _____

DATE OF MEETING	SUBJECT:	LOCATION
ACTION REQUIRED/COMPLIANCE		DUE DATE: _____
ASSIGNED TO: _____		ORIGINATOR
		AGENCY
FOLLOW UP STATUS: _____		
ASSIGNEE:		
DATE COMPLETED:		DOCUMENT NO.
COORDINATORS		TECHNICAL APPROVAL
PHONE _____	AGENCY _____	SIGNATURE _____ DATE _____
PHONE _____	AGENCY _____	SIGNATURE _____ DATE _____
PHONE _____	AGENCY _____	SIGNATURE _____ DATE _____
PROCURING ACTIVITY DATE	CONTRACTOR DATE	CONTRACTS DATE

Figure 2. Sample Action Item Form

FCA CHECK SHEET FOR CPCIs

Nomenclature _____

CPCI No._____ Date _____

Contractor Requirements	Yes	No
1. CPCI Development Specification Available	___	___
2. Final draft CPCI Product Specification Available	___	___
3. CPCI Qualification (Category 1) Test Plan Approved	___	___
4. Qualification (Category 1) Test Procedures Submitted and Approved	___	___
5. Qualification Test Complete	___	___
6. Qualification Test Results Compiled and Available	___	___
7. Qualification Test Results Reviewed	___	___
8. Qualification Testing Witnessed	___	___
9. Qualification Test Report(s) Available	___	___

Comments_____

_____

_____

Figure 3. Sample Certification Attachment (1 of 7)

FUNCTIONAL CONFIGURATION AUDIT (FCA)

FOR

CI NO.(s)_____

CONTRACT NO._____

PRIME CONTRACTOR:

_____

_____

_____

EQUIPMENT MANUFACTURERS:

_____

_____

_____

APPROVED BY_____
(CONTRACTOR)

DATE_____

APPROVED BY_____
(PROCURING ACTIVITY)

DATE_____

DEFINITIONS:

COMMENT: A note explaining, illustrating, or critizing the meaning of a writing. Items of this nature should be explored by the contractor and/or the Procuring Activity, but corrective action is NOT necessary to successfully accomplish a FCA.

DEFICIENCY: Deficiencies consist of two types: (1) conditions of characteristics in any hardware/software which are not in compliance with specified configuration, or (2) inadequate (or erroneous) configuration, identification which has resulted, or may result in configuration items that do not fulfill approved operational requirements.

Figure 3. Sample Certification Attachment (2 of 7)

SCOPE/PURPOSE

Scope:

Functional Configuration Audit (FCA) was conducted on the following end item:

CPCI No.	Nomenclature	Version No.

PURPOSE: The purpose of this FCA was to verify that the CPCI(s) performance complies with the Part I Development Specification.

Figure 3. Sample Certification Attachment (3 of 7)

FUNCTIONAL CONFIGURATION AUDIT

CERTIFICATION SHEET NO. 1

(equipment/computer programs)

Contract: _____ Date _____

Contractor: _____

CI No.: _____

_____

Qualification Test Procedures and Results. The qualification test/analysis results have been reviewed to insure that testing is adequate, properly done, and certified. (All test procedures and interface documents shall be reviewed to assure that the documents have been approved by the Procuring Activity. All test data sheets shall be reviewed to assure that the test was witnessed by a representative of DCAS/AFPRO or the Procuring Activity.)

Attached is a list of the documents reviewed.

Check One

Procedures and results reviewed satisfy the requirements and are accepted. See Attachment for comments.

Attached is a list of deficiencies.

Signature(s) of FCA Team Member(s)

*_____ _____

_____ _____

_____ _____

_____ _____

_____ _____

_____ _____

*Sub-Team Chairperson

Figure 3. Sample Certification Attachment (4 of 7)

SPECIFICATION/TESTING REVIEW

CI No. _____ Nomenclature _____

Specification No. _____

Test Procedures _____

Spec Ref / TP Ref	Description	Test Result

Figure 3. Sample Certification Attachment (5 of 7)

FCA DEFICIENCY SUMMARY LIST

CI NO. _____ NOMENCLATURE _____

DEVELOPMENT SPECIFICATION SECTION 3, PARAGRAPH NO.	REPORT REFERENCE	DESCRIPTION	RESPONSIBILITY FOR CORRECTION	PLACE OF INSPECTION	REVIEWED BY

Figure 3. Sample Certification Attachment (6 of 7)

FORMAL QUALIFICATION REVIEW

(For Equipment/Computer Programs)

Contract: _____ Date _____

Contractor: _____

CI No.: _____

Formal Qualification Review. Qualification Test/Analysis results have been reviewed to verify that the actual performance of the CI/CPCI complies with its development specification and that sufficient test results are available to insure the CI/CPCI will perform in its system environment.

Attached is a list of the documents reviewed.

Check One

Results reviewed satisfy FQR requirements and the CI/CPCI is qualifor entry into the Government Inventory.

Results reviewed are unsatisfactory/insufficient for FQR. FQR will be delayed until it is determined that sufficient information on the CI/CPCI's Qualification is available.

Signature(s) of FQR Team Member(s)

_____ _____

_____ _____

_____ _____

_____ _____

_____ _____

Figure 3. Sample Certification Attachment (7 of 7)

SAMPLE CERTIFICATION ATTACHMENT

SAMPLE PCA CHECKLIST

The following hardware, computer program(s), documentation shall be available, and the following tasks shall be accomplished at the PCA.

Hardware:

Computer Program(s):

Documentation:	Yes	No
(1) Approved final draft of the CI product specification.	___	___
(2) A list delineating both approved and outstanding changes against the CI.	___	___
(3) Complete shortage list.	___	___
*(4) Acceptance test procedures and associated test data	___	___
*(5) Engineering Drawing Index.	___	___
*(6) Operating, maintenance, and illustrated parts breakdown manuals	___	___
*(7) List of approved material review board actions on waivers.	___	___
(8) Proposed DD Form 250, "Material Inspection and Receiving Report."	___	___
*(9) Approved nomenclature and nameplates.	___	___
(10) Manuscript copy of all CPCI handbooks/manuals.	___	___
(11) Computer program version description document.	___	___
(12) Current set of listings and updated flow charts for each CPCI.	___	___
(13) FCA minutes for each CI.	___	___

*Does not apply to CPCIs.

Figure 4. Certification Attachment for PCA (1 of 20)

SAMPLE PCA CHECKLIST (CONTINUED)

Tasks:		Yes	No
(1)	Define Product Baseline.	____	____
(2)	Specification Review and Validation.	____	____
*(3)	Drawing review.	____	____
*(4)	Review acceptance test procedures and results.	____	____
(5)	Review shortages and unincorporated design changes.	____	____
*(6)	Review deviations/waivers.	____	____
(7)	Examine proposed DD 250.	____	____
*(8)	Review contractors Engineering Release and Change Control System.	____	____
*(9)	Review system allocation document.	____	____
(10)	Review Positional Handbooks, Computer Program User's Manuals, and Computer Programming Manuals.	____	____
(11)	Review CPCI's for the following:		
	(a) Computer Program Component (CPC) descriptions and flow charts.	____	____
	(b) CPC interface requirements.	____	____
	(c) Data base characteristics, storage allocation charts and timing and sequencing characteristics.	____	____
*(12)	Review packaging plan and requirements.	____	____
(13)	Review status of Rights in Data.	____	____
(14)	Review CM Records and Status.	____	____
(15)	Review FCA Minutes Action Item.	____	____
(16)	Check compatibility of technical documentation with qualified CPCI.	____	____

*Does not apply to CPCIs.

Figure 4. Certification Attachment for PCA (2 of 20)

PHYSICAL CONFIGURATION AUDIT (PCA)

FOR

CI NO.(s) _____

CONTRACT NO. _____

PRIME CONTRACTOR:

_____

_____

_____

EQUIPMENT MANUFACTURERS:

_____

_____

_____

APPROVED BY _____ (DESIGNEE)
CONTRACTOR

DATE _____

APPROVED BY _____ (DESIGNEE)
PROCURING ACTIVITY

DATE _____

Figure 4. Certification Attachment of PCA (3 of 20)

DEFINITION OF TERMS

COMMENT - A note explaining, illustrating, or criticizing the meaning of a writing. Items of this nature should be explored by the contractor and/or the Procuring Activity, but corrective action is NOT necessary to successfully accomplish a PCA.

DISCREPANCY - A note explaining, illustrating, or criticizing the difference between writings. A note showing the variance between what exists and what is acceptable. Items of this nature shall be rectified by the contractor prior to successful accomplishment of a PCA.

Figure 4. Certification Attachment of PCA (4 of 20)

SCOPE/PURPOSE

A Physical Configuration Audit (PCA) was conducted on the following CPCIs:

CPCI NO.	NOMENCLATURE	VERSION NO.

The purpose of the PCA was to insure accuracy of the identifying documentation and to establish a product baseline.

Figure 4. Certification Attachment of PCA (5 of 20)

PHYSICAL CONFIGURATION AUDIT

CERTIFICATION SHEET NO. 1

(for equipment/computer programs)

Contract: AF _____ Date _____

Contractor: _____

_____

_____

Product Baseline. The following documents of the issue and date shown, comprise the Product Baseline for the listed equipments/computer programs:

SPEC NO.	***ASSEMBLY TOP DRAWING NO.	ISSUE	COMP PRGM NOMENCLATURE	CI NO.

Signature(s) of PCA Team Member(s)

** _____	_____
* _____	_____
_____	_____
_____	_____
_____	_____
_____	_____

*** Not Applicable to CPCIs
** Team Chairperson
* Sub-Team Chairperson

Figure 4. Certification Attachment of PCA (6 of 20)

PHYSICAL CONFIGURATION AUDIT

CERTIFICATION SHEET NO. 2
(for computer programs)

Contract: AF_____ Date_____

Contractor: _____

_____

_____

Specification Review and Validation. Specifications have been reviewed and validated to assure that they adequately define the CPCI.

Check One

The Type C/Part II Specifications are complete and adequately define the CI. They shall, therefore, constitute the Product Baseline. See attachment for comments.

The Type C/Part II Specifications are unacceptable. Attached is a list of discrepancies.

Signatures of PCA Team Members

* _____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

*Sub-Team Chairperson

Figure 4. Certification Attachment of PCA (7 of 20)

A. Specification Review and Validation Instructions. The detailed specifications listed in paragraph B. below shall be reviewed for compliance with the applicable requirements. Each specification shall serve as the basic document for configuration control of the subject items. The information contained within the specifications shall be audited at the PCA.

B. Review and Validation Results:

1. Specifications Reviewed and Validated

SPEC. NO.	PARAGRAPH NO.	DATE	COMP PGM NOMENCLATURE	CI NO.

2. Specifications Reviewed and Disapproved:

(Provide attachment for causes.)

Figure 4. Certification Attachment of PCA (8 of 20)

PHYSICAL CONFIGURATION AUDIT

CERTIFICATION SHEET NO. 5

(for equipment/computer programs)

Contract: AF_____ Date_____

Contractor: _____

_____

_____

Review of Shortages and Unincorporated Design Changes. The shortages and unincorporated design changes listed on the proposed DD Form 250, "Material Inspection and Receiving Report," and other records have been reviewed.

Check One

There are no shortages or unincorporated design changes.

Attachment_____is a list of shortages and/or unincorporated design changes, and the recommended corrective action required.

Signature(s) of PCA Team Member(s)

* _____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

*Sub-Team Chairperson

Figure 4. Certification Attachment for PCA (9 of 20)

A. Review of Shortages and unincorporated Design Changes. All shortages and unincorporated design changes listed on the proposed DD Form 250, "Material Inspection and Receiving Report", shall be reviewed by the Procuring Activity or their designated representatives for a determination of what changes should be accomplished in the field and what changes should be accomplished at the contractor's facility. The Procuring Activity shall also determine if the reported shortages and unincorporated changes are complete.

B. Results. List the shortages and unincorporated design changes that were reviewed in compliance with requirements.

Figure 4. Certification Attachment for PCA (10 of 20)

PHYSICAL CONFIGURATION AUDIT

CERTIFICATION SHEET NO. 6

(for equipment/computer programs)

Contract: AF_____ Date_____

Contractor: _____

_____

_____

Review Deviations/Waivers. A review of all deviations/waivers to military specifications and standards that have been approved. The purpose is to determine the extent to which the equipment(s) undergoing PCA vary from applicable specifications and standards and to form a basis for satisfactory compliance with these specifications and standards.

In accordance with this paragraph, all applicable deviations/waivers have been reviewed with the following results:

Check One

The equipment(s)/computer program(s) listed on Certification Sheet No. 1 of this report complies with all applicable specifications and standards. (See Attachment___for comments).

Attachment___is a list of discrepancies and/or comments.

Signature(s) of PCA Team Member(s).

* _____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

* Sub-Team Chairperson

Figure 4. Certification Attachment of PCA (11 of 20)

A. Deviation/Waiver Review Team Instruction. All approved waivers and deviations to military specifications and standards shall be reviewed and recorded. Also, record any part of the PCA which fails to meet specifications or standards but is not an approved waiver/deviation.

B. Results of Team Review. List the deviations/waivers against the equipment/computer programs being PCA's that were reviewed.

Figure 4. Certification Attachment of PCA (12 of 20)

PHYSICAL CONFIGURATION AUDIT

CERTIFICATION SHEET NO. 7
(for equipment/computer programs)

Contract: AF_____ Date_____

Contractor: _____

_____

_____

Examination of the Proposed DD 250. The DD Form 250 has been examined to insure that it adequately defines the equipment/computer programs and that unaccomplished tasks are included as deficiencies.

Check One

The DD Form 250 adequately defines the equipment/computer program and all unaccomplished tasks are included as deficiencies.

Attachment____is a list of discrepancies and/or comments.

Signature(s) of PCA Team Member(s)

*_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

*Sub-Team Chairperson

Figure 4. Certification Attachment of PCA (13 of 20)

A. Examination of the Proposed DD Form 250. The proposed DD Form 250 shall be examined for completeness and an accurate definition of the equipment/computer programs. Unaccomplished tasks, shortages, and certain specified discrepancies uncovered at the PCA shall be included in the DD Form 250. If the equipment/computer programs is to be shipped from the plant, the Program Office representative will recommend to the CAO that the DD Form 250 be executed in accordance with the terms of the contract.

B. Results. Include a statement that the proposed DD 250 was examined and was recommended.

Figure 4. Certification Attachment of PCA (14 of 20)

PHYSICAL CONFIGURATION AUDIT

CERTIFICATION SHEET NO. 10

(FOR COMPUTER PROGRAMS)

CONTRACT: AF _____ DATE _____
CONTRACTOR: _____
_____
_____

REVIEW POSITIONAL HANDBOOKS, COMPUTER PROGRAM USER'S MANUALS, AND COMPUTER PROGRAMMING MANUALS.

	CHECK ONE	
	COMPLETE & ADEQUATE	UNACCEPTABLE
(A) POSITIONAL HANDBOOKS		
(B) COMPUTER PROGRAMMER USER'S MANUAL		
(C) COMPUTER PROGRAMMING MANUALS		

FOR UNACCEPTABLE PRODUCTS SEE ATTACHED LIST OF DISCREPANCIES

SIGNATURES OF PCA TEAM MEMBERS

* _____ _____
_____ _____
_____ _____
_____ _____
_____ _____
_____ _____

*SUB-TEAM CHAIRPERSON

Figure 4. Certification Attachment of PCA (15 of 20)

PHYSICAL CONFIGURATION AUDIT

CERTIFICATION SHEET NO. 11

(FOR COMPUTER PROGRAMS)

CONTRACT: AF _____ DATE _____

CONTRACTOR: _____

_____

_____

_____

REVIEW CPCI PRODUCT SPECIFICATION FOR THE FOLLOWING:

(A) COMPUTER PROGRAM COMPONENTS (CPC) DESCRIPTIONS AND FLOW CHARTS

(B) CPC INTERFACE REQUIREMENTS

(C) DATA BASE CHARACTERISTICS, STORAGE ALLOCATION CHARTS AND TIMING AND SEQUENCING CHARACTERISTICS

	CHECK ONE	
	COMPLETE & ADEQUATE	UNACCEPTABLE
(A) CPC DESCRIPTIONS AND FLOW CHARTS		
(B) CPC INTERFACES		
(C) DATA BASE, STORAGE AND TIMING INFORMATION		

FOR UNACCEPTABLE PRODUCTS SEE ATTACHED LIST OF DISCREPANCIES

SIGNATURES OF PCA TEAM MEMBERS

* _____ _____

_____ _____

_____ _____

_____ _____

_____ _____

_____ _____

*SUB-TEAM CHAIRPERSON

Figure 4. Certification Attachment of PCA (16 of 20)

PHYSICAL CONFIGURATION AUDIT

CERTIFICATION SHEET NO. 13

(FOR COMPUTER PROGRAMS)

CONTRACT: AF _____ DATE _____
CONTRACTOR: _____
_____
_____
_____

REVIEW STATUS OF RIGHTS IN DATA

CHECK ONE

NO RIGHTS IN DATA PROBLEM EXIST WITH THIS CPCI

ATTACHMENT ___ SPECIFIES RIGHT ON DATA RESTRICTIONS

SIGNATURES OF PCA TEAM MEMBERS

* _____ _____
_____ _____
_____ _____
_____ _____
_____ _____
_____ _____

*SUB-TEAM CHAIRPERSON

Figure 4. Certification Attachment of PCA (17 of 20)

PHYSICAL CONFIGURATION AUDIT

CERTIFICATION SHEET NO. 14
(FOR COMPUTER PROGRAMS)

CONTRACT: AF _____ DATE _____
CONTRACTOR: _____
_____
_____

REVIEW CM RECORDS AND STATUS

THE CM STATUS ACCOUNTING RECORDS HAVE BEEN REVIEWED AND FOUND TO BE UP-TO-DATE AND ACCURATE.

	CHECK ONE	
	COMPLETE & ADEQUATE	UNACCEPTABLE
(A) CONFIGURATION INDEX (COMPUTER PROGRAM)		
(B) CHANGE STATUS REPORT		
(C) VERSION DESCRIPTION DOCUMENT		

FOR UNACCEPTABLE PRODUCTS SEE ATTACHED LIST OF DISCREPANCIES

SIGNATURES OF PCA TEAM MEMBERS

* _____ _____
_____ _____
_____ _____
_____ _____
_____ _____
_____ _____

*SUB-TEAM CHAIRPERSON

Figure 4. Certification Attachment of PCA (18 of 20)

PHYSICAL CONFIGURATION AUDIT

CERTIFICATION SHEET NO.15

(FOR COMPUTER PROGRAMS)

CONTRACT: AF _____ DATE _____
CONTRACTOR: _____
_____
_____
_____

REVIEW FCA MINUTES ACTION ITEMS. DETERMINE THE DISPOSITION OF ALL ACTION ITEMS LISTED ON THE FCA MINUTES.

CHECK ONE

ALL ACTION ITEMS HAVE BEEN CLOSED SATISFACTORILY. OUTSTANDING ACTION ITEMS ARE SCHEDULED FOR QUALIFICATION POST PCA AND AN FQR IS SCHEDULED FOR AUDITING THE RESULTS.

ATTACHMENT____ IS A LIST OF OUTSTANDING ACTION ITEMS ALONG WITH CURRENT STATUS

SIGNATURES OF PCA TEAM MEMBERS

* _____ _____
_____ _____
_____ _____
_____ _____
_____ _____
_____ _____

*SUB-TEAM CHAIRPERSON

Figure 4. Certification Attachment of PCA (19 of 20)

PHYSICAL CONFIGURATION AUDIT

CERTIFICATION SHEET NO.16
(FOR COMPUTER PROGRAMS)

CONTRACT: AF _____ DATE _____
CONTRACTOR: _____
_____
_____
_____

CHECK COMPATIBILITY OF TECHNICAL DOCUMENTATION WITH QUALIFIED CPCI

CHECK ONE

ALL TECHNICAL DOCUMENTS ARE COMPATIBLE WITH THE CPCI AND ARE FOUND TO BE ACCEPTABLE.

ATTACHMENT ___ LISTS THE TECHNICAL DOCUMENTS FOUND TO BE ACCEPTABLE ALONG WITH DESCRIPTION OF DISCREPANCIES

SIGNATURES OF PCA TEAM MEMBERS

* _____ _____
_____ _____
_____ _____
_____ _____
_____ _____
_____ _____

*SUB-TEAM CHAIRPERSON

Figure 4. Certification Attachment of PCA (20 of 20)

SECTION 6 - REVIEWS AND AUDITS PROBLEM AREAS

This section identifies some of the more common problems created by improper implementation of reviews and audits requirements. In addition, it discusses how engineering design reviews can be used to prevent other common and serious problems.

6.1 RESPONSIBILITY AND AUTHORITY

PO personnel must have a clear understanding of their responsibility and authority during the conduct of an engineering design review. This is particularly true during PDR and CDR. Because many design review participants are technically qualified to design the CPCI, there is a tendency during the review to suggest design improvements. However, the Air Force is buying a CPCI that performs in accordance with a CPCI Development (Part I) Specification. The contractor is responsible for the CPCI design. If there are design defects, PO personnel are obligated to identify these defects to the contractor, but the design solution is the responsibility of the contractor. The concern here is that the PO should not "constructively change the contract" by identifying a new design that the contractor should implement. When a contractor is directed to implement a specific design, the design may be in conflict with the performance requirements specified in the CPCI Development Specification. When this occurs the contractor may be legally relieved of his responsibility to satisfy the performance requirements.

6.1.1 Requirements

Prior to conducting engineering design reviews, the review team should be briefed on its responsibilities. The PO should identify defects and allow the contractor to provide the solutions. Suggestions may be offered, but they should be clearly identified as such. (See "ESD Program Manager's Handbook," Chapter 19, for a discussion of the theory of constructive change.)

6.2 CPCI DEVELOPMENT (PART I) SPECIFICATION

One of the most serious problems encountered in the acquisition of CPCIs, is the inadequacy of the CPCI Development Specification. Major causes of this problem include the contractor's lack of expertise in Development Specification preparation and the PO's lack of technically qualified review personnel. Preparation of a Development Specification requires system engineering expertise as well as knowledge of the operational aspects of the system. The software contractor often assigns software experts to perform this task and the resultant requirements are usually stated in data processing terms rather than system performance (operational) terms. This results in an incomplete specification written at the wrong level. This problem is further compounded when the PO does not allocate sufficient time for the contractor to generate the specification.

6.2.1 Recommendations

When conducting the SRR and the SDR, the PO should determine the capability and experience of the contractor's technical team. During the generation of a CPCI Development Specification the contractor should be using his system engineering organization to define requirements. This organization should be supported by data processing experts whose job is to determine the feasibility of the stated requirements. In reviewing the performance requirements at SRR and SDR the PO should assure that:

- Requirements are stated in performance terms.
- CPCI interfaces are identified and specified.
- The functional relationships have been identified.
- Only the necessary design constraints are identified.

See the Computer Program Development Specification guidebook for further discussion of contents.

Any time there is a question regarding the adequacy of the Development Specification it is better to delay authentication until the inadequacies have been corrected. This is especially true for a contract for Full-Scale Development which absorbs the Validation Phase effort at the front end. In this case, there may be a change of the contract specification from the System/System Segment Specification to the individual CI/CPCI Development (Part I) Specification. It is essential that these be sound documents. Many ESD contracts attempt to dispose of this problem of changing baselines by inserting a statement in the contract such as "notwithstanding any other provisions of this contract the contractor is not relieved from meeting the performance requirements in the System Specification." The fact that this statement is embedded in the contract does not necessarily hold the contractor to the System Specification. If during the execution of the contract the Government takes steps to authenticate (approve) the CI Development Specification, this action may make the statement null and void. When the Government approves a specification, that specification becomes a Government specification and the contractor's responsibility is to implement the requirements of the approved specification. Faced with this situation, PO personnel should seek guidance from the Procurement Office.

6.3 SCHEDULING FOR PDR

The PDR should be conducted when the contractor is prepared to present his overall CPCI design. Often the schedule and agenda for PDR are not appropriate for this objective. In some cases the PDR is used as a review session for the Development (Part I) Specification. If the Development Specification was not authenticated prior to PDR, then the objective of reviewing the CPCI cannot be met because the design must be based upon the Development Specification. Also, PDR is customarily held 60-90 days after start of the Full-Scale Development Phase. This may not be sufficient time to prepare the design (and required trade studies) for a complex CPCI.

6.3.1 Recommendations

The contractor should be allowed to propose a PDR schedule consistent with the overall design requirements of the CPCI. The Development Specification should be authenticated at the beginning of the Full-Scale Development Phase. At most, the PDR should be used to review information that will replace TBDs in the Development Specification. The use of TBDs at the time of authentication should be minimized and localized to specific interface contents and formats that are not known at the time of authentication. The specification should not have whole sections marked TBD. Furthermore, the TBDs should be limited so that when the information is supplied, it will not impact contract costs or schedules. Whenever TBDs are used, specific responsibility and schedules should be assigned for supplying the required information.

6.4 SCHEDULING OF CDR

CDR schedules are often rushed. When this happens insufficient design is performed prior to CDR. Although the insufficient design is not always apparent during CDR, it becomes obvious sometime after coding begins and rework is required.

6.4.1 Recommendations

Assure that the contractor has all required data available for the design reviews. If it is not available, reschedule the design review meeting or review the available data and identify the missing information in the minutes. The contractor should be required to schedule the presentation of the missing information and the PO should then plan a follow-up design review meeting.

(Page 76 blank)

APPENDIX A - GLOSSARY

This appendix consists of (1) definitions of major terms used throughout this guidebook and (2) abbeviations used herein.

DEFINITIONS

Authenticate. Approval signature by a responsible person of the procuring activity. Authentication by the procuring activity normally will be accomplished on that issue of the specification which is to be the contractual requirement for the baseline which that particular specification defines [MIL-STD-483 (USAF)].

Certification. To verify that the requirements have been satisfied. Appendix G of MIL-STD-1521A (USAF) refers to the Government officially recognizing that the CI has been qualified and certifying to that effect. The use of the word certification herein is in accordance with the Webster definition. The use of the term certification in this guidebook differs from the use within the "Validation and Certification Guidebook."

Computer Program Configuration Item (CPCI). A computer programming end product whose development and subsequent modification is subject to configuration management.

Computer Programming Test and Evaluation. Tests conducted prior to and in parallel with preliminary or Formal Qualification Tests. These tests are oriented primarily toward the support of the contractor's design and development process.

Configuration Item (CI). An aggregation of hardware/computer programs or any of its discrete portions, which satisfies an end-use function and is designated by the Government for configuration management. CIs may vary widely in complexity, size, and type, from an aircraft, electronic, or ship system to a test meter or round of ammunition (abbreviated, from AFR 65-3).

Critical Design Review (CDR). A formal technical review of the design as depicted by the specification and flow diagrams, sufficiently detailed to enable the programmer to code and to assure that desigr requirements have been met before beginning coding.

Development Specification. A document applicable to a CI which states all necessary requirements in terms of performance, interface, design constraints, functional characteristics, and the tests required to demonstrate achievement of those requirements (see MIL-STD-490A for subtypes of Development Specifications).

Formal Qualification Review (FQR). The test, inspection, or analytical process by which products at the end item or critical-item level are verified to have met specific procuring activity contractual performance requirements (specification or equivalent).

Formal Qualification Tests (FQT). Formal tests oriented toward testing of the functional and performance characteristics of the CPCI, normally using operationally configured equipment at the System DT&E site prior to the beginning of System DT&E.

Full-Scale Development Phase. The period when the system/equipment and the principal items necessary for its support are designed, fabricated, tested, and evaluated. The intended output is, as a minimum a preproduction system which closely approximates the final product, the documentation necessary to enter the production phase, and the test results which demonstrate that the production product will meet stated requirements (DODI 5000.1/AFR 800-2).

Functional Configuration Audit (FCA). A formal audit to validate that the development of a CI has been completed satisfactorily and that the CI has achieved the performance and functional characteristics specified in the functional or allocated configuration identification.

Functional Flow Analysis. An iterative process used in identifying, analyzing, detailing, and sequencing the system functions thru the use of functional flow charts. The term function being an operation the system must perform to fulfill its intended mission.

Qualification. The entire process by which products are obtained from manufacturers or distributors, examined, and tested.

Physical Configuration Audit (PCA). A formal examination of the technical documentation (specification, handbooks, and manuals) to determine their compatibility with the qualified CPCI.

Preliminary Design Review (PDR). A formal review of the preliminary design of a CI to (1) evaluate technical progress, (2) determine its compatibility with the requirements of the CI Development Specification, and (3) establish the existance and compatibility of the physical and functional interfaces among CI equipment, facilities, computer programs, and personnel.

Preliminary Qualification Tests (PQT). Formal tests oriented primarily toward verifying portions of the CPCI prior to integrated testing/formal qualification tests of the complete CPCI. These tests will typically be conducted at the contractor's design and development facilities.

Product Specification. For a CPCI, a document which provides a detailed technical description of the CPCI [MIL-STD-490 and MIL-STD-483 (USAF)].

System Design Review (SDR). A design review conducted to evaluate the optimization, correlation, completeness, and risk associated with the allocated technical requirements.

System Requirements Review (SRR). A system engineering review to ascertain the adequacy of the contractor's efforts in defining system requirements. It will be conducted when a significant portion of the system functional requirements has been established.

System Segment Specification. A specification of the same format as a System Specification, identifying a discrete package of system performance requirements, functional interfaces and configuration items contracted to one contractor or assigned to one Government organization directly responsible for the procuring activity for that part of the system's performance.

System Specification. A document which states all the necessary technical and mission requirements in terms of performance, allocates requirements to functional areas (or CIs), defines the interfaces between or among the functional areas (or CIs), and includes the test provisions to assure the achievement of all requirements.

Validation Phase. The overall objective of the Validation Phase is to determine whether to proceed with Full-Scale Development. The ultimate goal of the Validation Phase, where development is to be performed by a contractor, is to establish firm and realistic performance specifications (Allocated Baseline), which meet the operational and support requirements.

Validation. Validation is the process by which the contractor tests operating and maintenance procedures for technical accuracy and adequacy.

Verification. Verification is the process by which operating and maintenance procedures are tested and proven under Air Force jurisdiction.

ACRONYMS AND ABBREVIATIONS

AFR	Air Force Regulation
C^3	Command, Control, and Communication
CDR	Critical Design Review
CI	Configuration Item
CPCI	Computer Program Configuration Item
CPDP	Computer Program Development Plan
CPT&E	Computer Program Test and Evaluation
DT&E	Development Test and Evaluation
ECP	Engineering Change Proposal
FCA	Functional Configuration Audit
FQR	Formal Qualification Review
FQT	Formal Qualification Test
PCA	Physical Configuration Audit
PCO	Program Contracting Officer
PDR	Preliminary Design Review
PO	Program Office
PQT	Preliminary Qualification Test
QQPRI	Quantitative and Qualitative Personnel Requirements Information
RSS	Regulations, Specifications, and Standards
SCN	System Change Notice
SD	Software Director
SDR	System Design Review
SE/TD	System Engineering/Technical Direction
SRR	System Requirements Review
WBS	Work Breakdown Structure

APPENDIX B - BIBLIOGRAPHY

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